

HISTORICAL BACKGROUND OF THE INCHEON BRIDGE PROJECT



Cho, Kyung-Won
President
Yooshin Engineering Corporation
chokw@yooshin.co.kr

Abstract: In October 2009, the ceremony for the completion of the Incheon Bridge will be held. The Bridge was created during the 10 years' Project period as a historical bridge with the state-of-the-art bridge construction technologies. It was the first successful case for the SOC infrastructure development, which was managed by the foreign investors in Korea. Also, the Incheon Bridge has been recognized as the world-class scale and outstanding structure and will largely contribute to the construction technology and the national development.

Keywords: Incheon Bridge, PPI, projectmManagement, fast track, cable-stayed bridge, SIP, AMEC, KEC

1. PROJECT DESCRIPTION

The Incheon Bridge is the Korea's longest bridge with the total length of 18.4km, connecting the Yeongjong Island and Songdo New Town. The bridge is not only a simple linking method between an island and the mainland but also a method connecting Korea and the world. Furthermore, it plays a major role for the local and national development by forming the national arterials. The Project will be recorded in the history as a world-renowned bridge that gives various lessons such as a world-class financing technique, an advanced project management, and comprehensive state-of-art bridge technologies. The Project has been completed with a long-story telling history for 10 years and become the first Private Participation in Infrastructure (PPI) Project led by a foreign company, AMEC. Also, it was a fine example that was successfully carried out by deriving the consensus from the local societies.

Overview of the project is shown in Table 1 and brief history is described in Table 2.

Table 1: Overview of the Incheon Bridge Project

| Items | | Private Invested Section | Government Financed Section |
|--------------------------------------|--------|--|------------------------------------|
| Location | | Yeongjong Island (Incheon International Airport) - Songdo New Town | |
| Length | Total | 12.34km (6Lanes) | 9.04km (2~6Lanes) |
| | | 21.38km (<i>embankment highway included</i>) | |
| | Bridge | 11.90km | 6.53km |
| | | 18.43km | |
| Construction Period | | Jun. 2005 ~ Oct. 2009 (52months) | Dec. 2005 ~ Oct. 2009 (46months) |
| Operation Period by Private Investor | | 30 Years after Bridge Opening | - |
| Project system | | PPI, BTO(Build-Transfer-Operate) | Turn-Key Base |
| Construction Cost | | KRW 1,592 Billion | KRW 858 Billion |
| | | KRW 2,450 Billion | |
| Concessionaire | | Incheon Bridge Co. Ltd. (IBC) ※ <i>Representative of the Government : KEC</i> | Korea Expressway Corporation (KEC) |
| Contractor | | Samsung JV | Kolon, Daelim, Hyundai, SK, Doosan |

Table 2: Main Activity in Time Frame

| Main Activity | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 |
|---|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----|
| ■ Private – Invested Incheon Bridge Project <ul style="list-style-type: none"> ● Mutual Understanding between Canadian and Korean Presidents ● Establishment of KODA Development Co. (former name of IBC) ● Submission of Private-Invested Project Proposal ● Completion of the Deliberation for the Project Proposal ● Designation of Preferred Negotiation Partner (AMEC) ● Designation of Concessionaire & Signing of the Concession Agreement ● Selection of Design & Construction Contractor (Samsung JV) ● Signing of the ARCA ● The Ground-Breaking Ceremony (MLTM & KEC) ● Completion of the Project | ▲ (Jul. 1999) | ▲ (Dec. 1999) | ▲ (Feb. 2000) | ▲ (Mar. 2000) | ▲ (Jul. 2001) | ▲ (Jun. 2003) | ▲ (May 2004) | ▲ (May 2005) | ▲ (Jun. 2005) | (Oct. 2009) ▲ | |
| ■ Government – Invested Connecting Road Project <ul style="list-style-type: none"> ● Order of the Construction Project (MLTM →KEC) ● Bidding for Construction ● Contract & the Ground – Breaking Ceremony ● Completion of the Project | | | | | | ▲ (Jun. 2004) | ▲ (Apr. 2005) | ▲ (Dec. 2005) | (Oct.2009) ▲ | | |

IBC : Incheon Bridge Co. Ltd. / ARCA: Amended and Restated Concession Agreement / KEC : Korea Expressway Corporation
MLTM: Ministry of Land, Transport and Maritime Affairs (former name was MOCT)

Figure 1: Overall View of Incheon Bridge



Figure 2: Layout of Incheon Bridge



2. BIRTH OF THE INCHEON BRIDGE PROJECT

2.1 Incheon City's Great Passion and Interest in the 2nd Bridge Connecting the Airport

Understanding on the Necessity of the New Bridge

After the New International Airport Expressway with Yeongjong Bridge was confirmed to be constructed, the necessity of the Incheon 2nd Bridge (former name of Incheon Bridge) was naturally grown in mind of people in Incheon City at the beginning of the 1990s. It was the reason that the bridge could accelerate the development of Songdo New Town and greatly affect the development of Incheon City.

Effort of Incheon City: Promoted as the Project of the Local Government

Incheon City was very passionate to promote the Incheon 2nd Bridge construction as stated below.

In 1994, Incheon City conducted the feasibility study that included a submarine tunnel as the Incheon 2nd Bridge.

In 1996, the City considered change of plan to a suspension bridge that was relatively economical and still wanted to be in charge. Since 1997, the City had tried to induce the private investment for the project.

In 1999, the City proposed early start of the Incheon 2nd Bridge Project by the central government when the former President D.J. Kim visited the City.

The Incheon 2nd Bridge was the former name of the Incheon Bridge, which was named by the Incheon citizens and the government in Jun. 2005.

2.2 Participation of the Foreign Company (AGRA): Blessed Start

Promotion Steps ;

- Jul. 5, 1999 : Mutual understanding reached during the summit meeting between Canadian and Korean Presidents (Expression of AGRA's Intention to Invest)
- Sep. 8, 1999 : AGRA signed on the LOI with MLTM and the MOU for foreign investment with Incheon City
- Feb. 28, 2000 : AGRA (KODA Development Co.) submitted the proposal for the private investment project.
(May 2000: AGRA was merged and acquired by AMEC)

The government decided to promote the Incheon 2nd Bridge as the Access Road of Incheon International Airport led by the central government after the summit meeting. (Ministry in Charge: MLTM)

At that time, Korea was suffering from the foreign exchange crisis and accordingly, it was nationally welcome to get the foreign investment. Consequently, the project could favorably start as the first PPI project led by the foreign company based on the combination of the passion and interests of the foreign company, AMEC, and the strong willingness of Incheon City.

3. HISTORICAL ACHIEVEMENT IN THE PROJECT

3.1 Model Case for the Private Investment

In Dec. 1999, KODA Development Co., which was composed of pure investors not involving construction companies, was established for the private investment project. After that, the private investment project was successfully carried out as shown in the brief history and organization chart in Table 2 and Figure 3 respectively. The Incheon Bridge Project was the first PPI (Private Participation in Infrastructure) project in Korea, which was invested and led by the foreign company, AMEC. The company participated in the project as a professional project manager and pure financial investor as shown in the organization chart below.

The Project played a significant role in breaking conventional practices in Korean Private Investment Project by applying the global standards and modern financing skills.

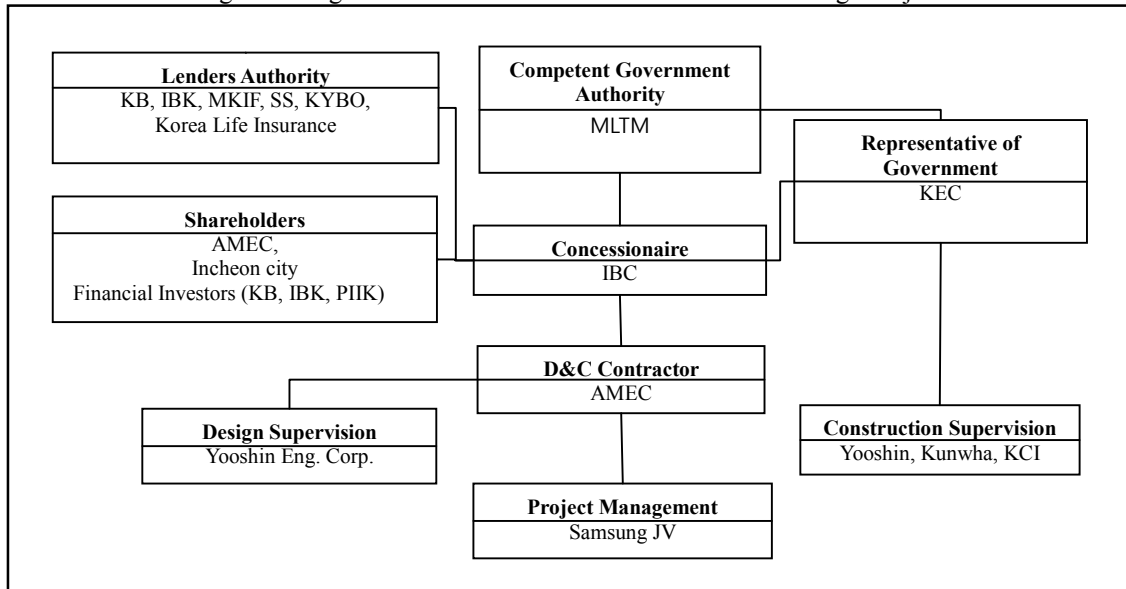
The project manager, AMEC, emphasized that success or failure of the private investment project would depend totally on whether the independence and responsibility of private investors would be secured or not. There were also lessons learned by signing the concession agreement with the fair and rational distribution of the responsibilities and rights with such philosophy.

One of the features of the Project was the clear distinction between investors and construction entities by selecting the construction contractors in a transparent open bid, considering the maximum value system.

As a result, the fair and efficient project structure was formed and then the reduction of the construction cost and government fiscal burden as well as the lower toll fees could be achieved.

The contract cost at the beginning was fixed and didn't change throughout the construction period. The project, such a successful case of the private investment project will be recorded as the historical lesson in the Korean construction history.

Figure 3: Organization of the Private-Invested Incheon Bridge Project



For the private-invested section of the project, the Fast-Track method was applied, which the design and construction are simultaneously carried out. This method enables significant reduction of construction period. Design check procedures were conducted systematically to implement the Fast-Track successfully. Various design checks were conducted by Contractor's Check Engineer (CCE), Design Supervision (DS), Construction Supervision (CS), and Technical Deliberation from the government side by KEC.

Project Management (PM) for the private-invested section was carried out by AMEC. Furthermore, the qualified expressway project manager, KEC, as an authority to act on behalf of the government, enables the successful performance of the project.

3.2 Successful Negotiation with the Local Society for the Concession Agreement

Way to Concession Agreement

To reach the concession agreement, KODA development Co. prepared the comprehensive results of feasibility study, basic design of bridges, various impact studies, and so on to get the approval of the government. More importantly, the results of impact studies have to be discussed and agreed by related societies including local residents.

It took approximately 5 years to sign on the ARCA after the Private-Investment Proposal was submitted in Feb. 2002. The main delay was caused by the procedures to obtain the mutual understanding on the ship navigation safety.

Comprehensive Feasibility Study and Basic Design of Bridge

Once the LOI for Investment was signed with the MOCT, the project implementation team was organized to perform the comprehensive feasibility study including the field investigation, environmental investigation, traffic demand forecast, connecting road plan, comparison with alternatives, and ship navigation simulations in compliance with the domestic and international standards.

Yooshin Engineering Corporation as a counterpart in Korea participated in the team carrying out the basic design for the bridge after Buckland & Tailor and verified the construction cost.

The connecting road was planned to maximize the efficiency of the Incheon Bridge by linking directly to the 2nd and 3rd Gyeongin Expressway.

Environmental Impact Assessment

Preliminary attention was paid to prevent the environmental problems by taking actions such as abandonment of the alternative of toll plaza on the sea.

In Feb. 2004, the Joint Investigation Team (JIT) was organized for the efficient environmental investigation and analysis and the consultation for the Environmental Impact Assessment (EIA) was completed in Sep. 2004.

With the great efforts put on the communication with the local residents, the advantages and mandatory procedures of the project were explained. As a result, the assessment was favorably implemented after obtaining the agreement and cooperation from the local residents.

Ship Navigation Safety Assessment: Great Compromise with the Ship-Related Associations

Promotion Steps ;

- Mar. 2001: KODA submitted the report of the ship navigation safety assessment. (Main span = 675m)
 - Jul. 2001: The bridge alignment was modified to be moved toward south by 900m for the safer navigation according to the suggestion from the ship navigation-related associations.
 - Jul. 2002: In the Economic Ministerial Meeting, the main span of 700m was decided in one condition that safety was to be reviewed during the basic design.
 - Feb. 2004: The Japanese Marine Science Association submitted the assessment report with the main span of 700m.
- (Long-period of discussion with the ship navigation-related associations requiring extension of the main span)
- Jul. 2004: The people's committee was organized. (Serious discussion to be continued)
 - Dec. 2004: The main span of 800m was finally agreed and decided.
 - May 2005: The ARCA was signed.

The ship navigation safety was the first priority and sensitive issue. The feasibility study with the ship navigation simulation was carried out comprehensively and the Japanese experts confirmed its liability. Although the main span of 700m was suitable for the national and international design standards, the ship navigation-related associations required the extension for the safer navigation and development of Incheon Port. Eventually, the agreement on the 800m plan was achieved after the successful negotiation with the attitude of respecting each other.

The government finally accepted the agreement and signed on the ARCA that reflected the raised project cost.

It was a successful example that solved the social conflict with the agreement through the review, discussion, and convincement even though it took 4 years from the initial review of ship navigation safety to the final agreement of the main span with the delay.

As stated above, the concession agreement was finalized and the splendid ground-breaking ceremony was held with the attendance of the former President M.H. Roh in Jun. 2004.

Figure 4: Ground-Breaking Ceremony



4. CREATION OF HISTORICAL BRIDGE

Largest and Longest Bridge of Korea – World Class Scale

| | |
|----------------------------|---|
| Total Length of Bridge | : 18.4 km (Longest in Korea and 6 th longest in the world) |
| Cable-Stayed Bridge Length | 1,480 m |
| Main span length | : 800 m (longest in Korea and 5 th longest in the world) |
| Pylon height | : 230.5 m (highest in Korea) |

Solid & Safe Bridge Design

Design Standard

| | |
|---|-------------------------------------|
| Project Performance Requirement(PPR) | ※ only for private-invested section |
| Concessionaire Supplementary Requirement(CSR) | ※ only for private-invested section |
| AASHTO LRFD Bridge specification. | ※ only for private-invested section |
| Korea Highway Bridge Design Code (KHBDC) | |

Design Load

Wind Load : 72 m/sec (Critical velocity)

Earthquake load : Intensity VIII (ground acceleration : 0.154 g)

Ship impact load : 100,000 DWT / 10 Knots ※ Risk analysis: annual failure probability: less than 1.0×10^{-4}

Design lifetime : more than 100 years

Various Type of Bridge Structure

Becoming a Sort of Exhibition of International Bridges

Table 3: Type of Structure

| Bridge | Type of Structure |
|-----------------|---------------------------|
| Offshore Bridge | Cable-stayed Bridge |
| | Approach span |
| | Viaduct span |
| Onshore Bridge | Zone 1 (Yeongjong Island) |
| | Zone 2 (Songdo) |
| | Zone 3 (Songdo) |
| | Zone 4 (Songdo) |
| | Zone 5 (Songdo) |



Figure 5. Arch bridge and V-shaped cable-stayed bridge in onshore site

High-Tech in Bridge Construction

- Features of construction method
- Mechanical and modular construction
- Minimization of the works on the sea
- Use of large scale equipments including 3000 tonf-class floating crane
- Application of most adequate modern high technology by structure types.

Table 4: Specific Construction Method for Offshore Site

| Structure | Construction Method |
|------------------------------|--|
| Cable Stayed Bridge | |
| - Pylon | ACS (Auto Climbing System) Form |
| - Superstructure (Main Span) | Small Block (15m) Erection by Derrick Crane |
| - Superstructure (Side Span) | Large Block (113m) Erection by 3000 ton-Floating Crane |
| - Substructure | RCD Pile (D=3.0m) |
| Approach Bridge | FCM (Free Cantilever Method) |
| Viaduct | FSLM(Full Span Launching Method) |

Figure 6: Main Span Small Block Erection



Figure 7: Side Span Large Block Erection



Figure 8: Free Cantilever Method (FCM)



Figure 9: Full Span Launching Method (FSLM)



The Fabrication Yard equipped with advanced automatic facilities produced building materials and modular segments. The advantages are as follows;

- Reduction of works on the sea
- Assurance of the quality control
- Reduction of construction period



Figure 10: Casting Yard on the Land

Historical Records in Construction

World's Largest Records

Pile load test with compressive load more than 30,000 tonf

Dolphin type ship impact protection: 100,000 DWT ship / 10 Knots (dolphin diameter is up to 25 m)

Domestic Largest Records

Piling work (Drilled Shafts): Diameter 3 m, Length 76 m

Pile-Cap PC House work

Pre-Casted FCM Bridge: Span Length 145 m (Longest)

First-ever Application in Korea

Pre-Tension for PSC Box Girder

FSLM (Full Span Launching System) for road bridge

Rebar Cage Automation System for drilled shaft foundation

Single Bent type Pile : Diameter is up to 3 m

5. WORLD CLASS BRIDGE ATTRACTING ATTENTION OF THE WORLD

Technical Aspects: “TEN WONDERS IN THE CONSTRUCTION WORLD”

Incheon Bridge was selected as one of the “TEN WONDERS IN THE CONSTRUCTION WORLD” by the UK “Construction News” on Dec. 8, 2005. The Incheon Bridge Project was regarded as an impressive scale and technology and well provided a positive stimulus not only to Korea but also to other Asian countries.

Financial Aspects: “THE BEST DEAL OF THE YEAR 2005”

Incheon Bridge project finance (PF) for private-investment section was awarded “THE BEST DEAL OF THE YEAR 2005” by Euro Money, a leading financial magazine in the UK. Euro Money selected the most remarkable events for innovation and excellence. Incheon Bridge was designated as “The 2005 best PF in Asia-Pacific transport infrastructure” by Euro Money. The Incheon Bridge Project was distinguished from other infrastructure – building projects in Korea in those financial investors. In Korea’s PPI history, The Incheon Bridge Project was the first project in which project concessionaire and construction contractors were totally separated.

Business Model Aspects: “THE TOP 25 NEWSMAKER OF THE YEAR 2007”

CEO of IBC has been nominated as one of “THE TOP 25 NEWSMAKER OF THE YEAR 2007” by ENR (Engineering News Record). The Incheon Bridge Project made the cover story of the issue of ENR in May 2007. ENR says that he established an innovative and transparent business model in Korean PPI division.

6. EXPECTED BENEFITS

Economic and Regional Development

Convenient Route : The Bridge connects Incheon International Airport with the 2nd and 3rd Gyeongin Expressway of the southern part of the Seoul Metropolitan Area. It will accelerate the development of the national transport and logistics network and reduce the travel time and cost.

Core infrastructure of IFEZ and 21st century Hub of Northeast Asia in the future : The bridge enables the connection between Korea and the world. It can be an alternative route between Yeongjong Island and Incheon mainland in emergency point of view.

This beautiful bridge on the sea will be a landmark of Asia as well as Korea.

Development of construction technology

Upgrade of domestic construction technologies : The Project upgraded Korea's international competitive power in view of civil engineering, project management and construction technologies.

Promotion of foreign private investments in construction projects in the future is also expected.

The Bridge made of the Technologies and Efforts in the Past Brings the National Prosperity in the Future.

Figure 11: Bridge of Prosperity



Figure 12: Bridge of Beauty

